CLAIMS

What is claimed is:

1. An apparatus for detecting intrusions within a protected region, comprising:

an infrared sensor assembly having at least four infrared sensing elements;

means for focusing infrared energy from a protected region upon said at least four infrared sensing elements; and

means for generating an intrusion signal in response to the registration of sufficient infrared activity within said protected region on multiple vertically arranged said infrared sensing elements.

2. An apparatus as recited in claim 1, wherein said means for focusing said infrared energy operates by altering the infrared energy direction by refraction, reflection or diffraction.

3. An apparatus as recited in claim 2, wherein said means for focusing said infrared energy comprises an array of optical elements for focusing said infrared energy.

4. An apparatus as recited in claim 3, wherein said array of optical elements are fabricated within a single optical assembly.

5. An apparatus as recited in claim 2, wherein said means for focusing infrared energy comprises a lens assembly.

6. An apparatus as recited in claim 2, wherein said means for focusing infrared energy comprises a mirror assembly.

7. An apparatus as recited in claim 1:

wherein the protection pattern within said protected region comprises non-overlapping upper and lower detection tiers;

wherein said infrared sensing elements are arranged as an upper tier and a lower tier;

wherein said means for focusing infrared energy is configured for focusing infrared energy from an upper tier of detection zones within said detection pattern to one tier of said infrared sensing elements and infrared energy from a lower tier of detection zones within said detection pattern to another tier of said infrared sensing elements.

8. An apparatus as recited in claim 7:

wherein said means for focusing infrared energy is configured with a longer focal length upper tier for focusing infrared energy to said sensing elements, and a shorter focal length lower tier for focusing infrared energy to said sensing elements;

wherein altering the focal lengths in said upper and lower tiers allows configuring desired levels of vertical separation between detection tiers within said detection pattern.

9. An apparatus as recited in claim 7, wherein said means for generating an intrusion signal is configured to detect levels of infrared energy on a vertically-oriented pair of sensing elements to discern animal intrusions registered upon any single sensing elements, from human intrusions which are registered as sufficient simultaneous activity on two vertically separated sensing elements.

10. An apparatus as recited in claim 9, wherein said means for generating an intrusion signal comprises a threshold circuit configured to receive electrical signals from said infrared sensing elements and to generate an intrusion alert upon registering a sufficient infrared activity level on said two vertically separated sensing elements.

11. An apparatus as recited in claim 9, further comprising a mode selection device coupled to said means for generating an intrusion signal for the selection of either a pet-immune mode or a non-pet-immune mode.

12. An apparatus as recited in claim 11:

wherein said means for focusing infrared energy operates to focus infrared energy from horizontally arranged detection zones within a non-overlapping upper and lower detection tier to an upper and lower pair of said infrared sensing elements;

wherein said means for generating an intrusion signal generates intrusion signals in response to registering a sufficient level of infrared activity on both said upper and lower detection tier within one or more vertically aligned detection zones when said pet-immune mode is selected;

wherein said means for generating an intrusion signal generates intrusion signals in response to registering a sufficient level of infrared activity on any of said detection zones within either of said upper or lower detection tier when said non-pet-immune mode is selected.

13. An apparatus as recited in claim 1, wherein said infrared sensing elements comprise at least a first infrared sensor channel connecting two horizontally-oriented infrared sensing elements in opposing polarity, and a second infrared sensor channel connecting two additional horizontally-oriented infrared sensing elements in opposing polarity.

14. An apparatus as recited in claim 1, wherein said infrared sensors are packaged as two dual- sensing element device packages.

15. An apparatus as recited in claim 1, wherein said infrared sensors are packaged in a single quad-sensing element device package.

16. An apparatus as recited in claim 1, wherein the centers of said infrared sensing elements are positioned within one half inch of one another.

17. An apparatus as recited in claim 1, wherein said infrared sensing elements comprise infrared sensors.

18. An apparatus as recited in claim 17, wherein said infrared sensors comprise pyroelectric infrared sensors.

19. An apparatus as recited in claim 1:

wherein said infrared sensing elements are configured in upper and lower horizontally-oriented pairs;

wherein said infrared sensing elements of each said horizontally-oriented pair are connected in opposing polarity;

wherein common-mode infrared energy simultaneous registered on each said sensing element of said horizontally-oriented pair of said infrared sensing elements is thereby rejected as common-mode noise.

20. An apparatus for detecting intrusions, comprising:

an infrared sensor assembly having at least four infrared sensing elements;

a lens assembly configured to focus infrared energy from non-overlapping upper and lower tiers of detection zones upon upper and lower pairs of said infrared sensing elements; and

a threshold circuit configured to generate an intrusion signal in response to receipt of a sufficient level of simultaneous infrared activity on vertically separated detection zones within said upper and lower tiers of detection zones.

21. An apparatus as recited in claim 20:

wherein vertical angular separation between detection zone tiers increases with increasing tier offset from the horizontal to the vertical;

wherein said lens assembly is configured having a longer focal length for focusing energy from the two upper tiers of detection zones to said sensing elements, and a shorter focal length for focusing infrared energy from said two lower tiers of detection zones to said sensing elements;

wherein altering the focal lengths in said upper and lower tiers allows configuring desired levels of vertical separation between detection zones within the detection tiers.

22. An apparatus as recited in claim 21:

wherein said threshold circuit is configured in a pet-immune mode to generate said intrusion signal in response to infrared activity occurring on both upper and lower rows of sensing elements; and

wherein said threshold circuit is configured in a non-pet-immune mode to generate said intrusion signal in response to infrared activity occurring on either upper or lower rows of sensing elements.

23. An apparatus as recited in claim 20, wherein the combination of said infrared sensing elements and said threshold circuit are configured for rejecting common mode infrared signals simultaneously received across horizontally-oriented sensing elements which increases immunity to false alarms.

24. An apparatus as recited in claim 23, wherein said horizontally adjacent sensing elements are connected in opposing polarity so that common mode signals are attenuated to reduce ambient and power-line noise contributions.

25. An apparatus as recited in claim 20, wherein said infrared sensors comprise pyroelectric infrared sensors.

26. An apparatus as recited in claim 20:

further comprising a mode selector for said threshold circuit which is configured to allow selecting either a pet-immune mode or a non-pet-immune mode;

wherein for said pet-immune mode intrusion signals are generated in response to sufficient levels of infrared activity being registered on a vertically-oriented pair of said infrared sensing elements;

wherein for said non-pet-immune mode intrusion signals are generated in response to sufficient levels of infrared activity being registered on any of said infrared sensing elements.

27. An apparatus as recited in claim 20, wherein said infrared sensors comprise at least a first sensor channel connecting two adjacent horizontal infrared

sensing elements in opposing polarity, and a second sensor channel connecting two additional adjacent horizontal infrared sensing elements in opposing polarity.

28. An apparatus as recited in claim 27, wherein said first sensor channel is positioned over said second sensor channel with alternating polarities in the vertical direction.

29. An apparatus as recited in claim 20, wherein said infrared sensing elements are packaged as two dual- sensing element device packages.

30. An apparatus as recited in claim 20, wherein said infrared sensing elements are packaged in a single quad- sensing element device package.

31. An apparatus as recited in claim 20, wherein said infrared sensors comprise pyroelectric infrared sensors.

32. An apparatus as recited in claim 20, wherein said lens assembly is configured with multiple lens elements to register infrared energy within multiple horizontal bands of detection zones arranged vertically.

33. An apparatus as recited in claim 32, wherein said lens assembly comprises two or more horizontally oriented tiers of lenses for focusing infrared energy to said infrared sensing elements from at least one non-overlapping pair of detection zone tiers.

34. An apparatus as recited in claim 32, wherein said lens assembly comprises at least four horizontally oriented tiers of lenses for focusing infrared energy to said infrared sensing elements from multiple pairs of non-overlapping detection zone tiers.

35. An apparatus as recited in claim 32, wherein said lens assembly comprises adjacent horizontal lenses which focus infrared energy from detection

zones within the protected region of the apparatus.

36. An apparatus as recited in claim 20, wherein said threshold circuit comprises a microprocessor coupled to said infrared sensors and configured for receiving signals from said infrared sensors in response to infrared intensity.

37. An apparatus as recited in claim 20, wherein the mechanical configuration of lenses and/or infrared sensors need not be altered to switch operating modes between a pet-immune mode, and a non-pet-immune mode.

38. An apparatus for detecting intrusions, comprising:

an infrared sensor assembly having at least four infrared sensing elements arranged in at least two horizontally-oriented sensor tiers ;

a lens assembly configured to focus infrared energy from non-overlapping upper and lower tiers of detection zones to said sensor tiers; and

a threshold circuit coupled to said sensor tiers and configured to generate an intrusion signal in response to infrared activity; and

a mode selector input coupled to said threshold circuit for selecting either a pet-immune operating mode or a non-pet-immune operating mode;

wherein said threshold circuit operates within said pet-immune mode by generating intrusion signals in response to a sufficient level of infrared activity registered on at least two tiers of detection zones which are vertically adjacent to one another;

wherein threshold circuit operates within said non-pet-immune mode by generating intrusion signals in response to a sufficient level of infrared activity registered on any of said infrared sensing elements.

39. An apparatus as recited in claim 38:

wherein said lens assembly is configured having a longer focal length for focusing infrared energy from the two upper tiers of detection zones to said sensing elements, and a shorter focal length for focusing infrared energy from said two lower tiers of detection zones to said sensing elements;

wherein altering the focal lengths in said upper and lower tiers allows configuring desired levels of vertical separation between detection zones within the detection tiers.

40. A method of discriminating human intrusion from animal intrusion within an infrared detection area, comprising:

registering infrared intensity within the infrared detection area as received from at least two stacked non-overlapping detection tiers each having a plurality of non-overlapping detection zones;

rejecting common infrared signals simultaneously occurring on horizontally adjacent detection zones within a given said detection tier; and

generating an intrusion signal indicative of the presence of human intruders in response to registering sufficient simultaneous infrared activity on vertically adjacent detection zones in at least two of said stacked detection tiers.

41. A method as recited in claim 40, further comprising generating an intrusion signal indicative of intruders having a heat signature shorter than a standing human, said intrusion signal generated in response to registering sufficient infrared activity on any of said detection zones of said stacked detection tiers.

42. A method as recited in claim 40, further comprising a mode selector input configured for determining whether an intrusion signal should be generated in response to sufficient infrared activity on any of said detection zones within a non-pet-immune mode, or requiring sufficient infrared activity on vertically adjacent detection zones within a pet-immune mode.

43. A method as recited in claim 40, wherein said infrared sensors comprise pyroelectric infrared sensors.

44. A method as recited in claim 40, wherein said stacked non-overlapping detection tiers are configured with sufficient vertical separation so that a standing, or semi-standing human, will be simultaneously registered in at least two vertically

adjacent detection zones.

45. A method as recited in claim 40:

further comprising focusing said infrared energy with a long focal distance for detection tiers having long detection zones and a shorter focal distance for detection tiers having shorter detection zones;

wherein altering the focal lengths in said tiers allows configuring desired levels of vertical separation between vertically adjacent detection zones of said detection tiers.